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(54) IMAGE ENCODER AND ENCODING METHOD

(57)Abstract:
PROBLEM TO BE SOLVED: To realize a target code amount in one-time encoding processing, to realize code amount control with less calculation load and storage load and with high encoding efficiency and to realize stable code amount control not only in a still picture but also in a moving picture even in various kinds of moving pictures.
SOLUTION: A picture encoder is provided with a wavelet converting part 1, a bit plane encoding pass generating part 2 for generating an encoding pass at each bit plane, a calculation encoding part 3 for performing calculation encoding in the encoding pass, a rate control part 4 for controlling the code amount to obtain the target code amount from the generated calculation codes, a packet generating part 6 for adding a header to the calculation code after code amount control and generating a packet and an

encoding code stream rounding means for processing the whole encoding passes, generating an encoding code stream and, then, rounding off the rear part of the encoding code stream to obtain the target code amount.

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CLAIMS

[Claim(s)]
[Claim 1] A filtering means to give a low-pass filter and a high-pass filter vertically and horizontally to an input image, A bit plane generation means to develop the multiplier after the above-mentioned filtering to the bit plane from the most significant bit (MSB) to the least significant bit (LSB), A coding pass generation means to generate coding pass for every above-mentioned bit plane, An algebraic-sign-ized means to perform algebraic-sign-ization within the above-mentioned coding pass, and the amount control means of signs which controls the amount of signs to become the target amount of signs from the generated algebraic sign, In the image coding

equipment which generates the packet by the coding code stream of the predetermined format constituted by having a packet generation means to add a header to the algebraic sign after the amount control of signs, and to generate a packet Image coding equipment characterized by having a coding code stream cut-off means to omit the back of a coding code stream so that it may become the target amount of signs after processing all **** coding pass and generating a coding code stream.

[Claim 2] A filtering means to give a low-pass filter and a high-pass filter vertically and horizontally to an input image, A bit plane generation means to develop the multiplier after the above-mentioned filtering to the bit plane from the most significant bit (MSB) to the least significant bit (LSB), A coding pass generation means to generate coding pass for every above-mentioned bit plane, An algebraic-sign-ized means to perform algebraic-sign-ization within the above-mentioned coding pass, and the amount control means of signs which controls the amount of signs to become the target amount of signs from the generated algebraic sign, In the image coding equipment which generates the packet by the coding code stream of the predetermined format constituted by having a packet generation means to add a header to the algebraic sign after the amount control of signs, and to generate a packet Image coding equipment characterized by having a coding termination means to stop coding by the **** coding pass generation means when the amount of signs of the target set up beforehand is reached.

[Claim 3] A filtering means to give a low-pass filter and a high-pass filter vertically and horizontally to an input image, A bit plane generation means to develop the multiplier after the above-mentioned filtering to the bit plane from the most significant bit (MSB) to the least significant bit (LSB), A coding pass generation means to generate coding pass for every above-mentioned bit plane, An algebraic-sign-ized means to perform algebraic-sign-ization within the above-mentioned coding pass, and the amount control means of signs which controls the amount of signs to become the target amount of signs from the generated algebraic sign, In the image coding equipment which generates the packet by the coding code stream of the predetermined format constituted by having a packet generation means to add a header to the algebraic sign after the amount control of signs, and to generate a packet Have a storage means to memorize beforehand the coding number of passes for every subband generated by **** filtering, and a coding pass termination means to end **** coding pass within this coding number of passes with a **** coding pass generation means.

[Claim 4] Image coding equipment characterized by having a coding code stream cut-off means to omit the back of a **** coding code stream so that it may become the target amount of signs when the coding code stream generated by the **** coding pass generation means is over the target amount of signs in image coding

equipment according to claim 3.

[Claim 5] Image coding equipment characterized by having a storage means to memorize two or more patterns of the coding number of passes for every subband, and the change means which changes a **** pattern with an input image in the above-mentioned coding pass generation means in image coding equipment according to claim 3.

[Claim 6] In image coding equipment according to claim 5, the change means which changes the pattern of the coding number of passes for every above-mentioned subband When it is the dynamic image with which the input image continued and the amount of signs generated with the coding frame in front of one is larger than the target amount of signs Image coding equipment characterized by having a selection means to choose the pattern which the amount of signs cannot generate more easily, and to choose the pattern which the amount of signs tends to generate when conversely smaller than the target amount of signs.

[Claim 7] The change means which changes the pattern of the coding number of passes for every above-mentioned subband in image coding equipment according to claim 5 is image coding equipment characterized by having the threshold judging means which changes a pattern by the threshold judging of the characteristic quantity extracted from the present coding frame when it is the dynamic image with which the input image continued.

[Claim 8] It is image coding equipment characterized [in the pattern generation of the coding number of passes by the change means which changes the pattern of the coding number of passes for every above-mentioned subband] in image coding equipment according to claim 5 by to have a setting-out means set up many coding numbers of passes in a subband, and set up the coding number of passes in a subband few as a pattern which make the amount generating of signs hard to carry out as a pattern make a pattern easy to carry out the amount generating of signs.

[Claim 9] It is image coding equipment characterized by performing coding independently for every block of predetermined magnitude, straddling a **** block and not performing statistic measurement of algebraic-sign-izing in image coding equipment according to claim 1 in a coding pass generation means to generate coding pass for every above-mentioned bit plane.

[Claim 10] It is image coding equipment characterized by performing coding independently for every block of predetermined magnitude, straddling a **** block and not performing statistic measurement of algebraic-sign-izing in image coding equipment according to claim 2 in a coding pass generation means to generate coding pass for every above-mentioned bit plane.

[Claim 11] It is image coding equipment characterized by performing coding independently for every block of predetermined magnitude, straddling a **** block and not performing statistic measurement of algebraic-sign-izing in image coding

equipment according to claim 3 in a coding pass generation means to generate coding pass for every above-mentioned bit plane.
[Claim 12] Image coding equipment characterized by forming a quantization means to quantize the filter coefficient of a subband after the above-mentioned filtering means, in image coding equipment according to claim 1 in the pre-stage of a coding pass generation means to generate coding pass for every above-mentioned bit plane.
[Claim 13] Image coding equipment characterized by forming a quantization means to quantize the filter coefficient of a subband after the above-mentioned filtering means, in image coding equipment according to claim 2 in the pre-stage of a coding pass generation means to generate coding pass for every above-mentioned bit plane.
[Claim 14] Image coding equipment characterized by forming a quantization means to quantize the filter coefficient of a subband after the above-mentioned filtering means, in image coding equipment according to claim 3 in the pre-stage of a coding pass generation means to generate coding pass for every above-mentioned bit plane.
[Claim 15] It is image coding equipment characterized by realizing by doing the division of the wavelet transform multiplier of the subband with which the above-mentioned quantization means was generated in image coding equipment according to claim 12 with the quantization step size of the Scala value.
[Claim 16] It is image coding equipment characterized by realizing by doing the division of the wavelet transform multiplier of the subband with which the above-mentioned quantization means was generated in image coding equipment according to claim 13 with the quantization step size of the Scala value.
[Claim 17] It is image coding equipment characterized by realizing by doing the division of the wavelet transform multiplier of the subband with which the above-mentioned quantization means was generated in image coding equipment according to claim 14 with the quantization step size of the Scala value.
[Claim 18] the image coding equipment characterized by level and realizing with a filtering means to hang a vertical filter to these images field in image coding equipment according to claim 1 as soon as it is accumulated with the are recording means which only a predetermined field carries out reading appearance of the image to memory, and the above-mentioned filtering means accumulates.
[Claim 19] the image coding equipment characterized by level and realizing with a filtering means to hang a vertical filter to these images field in image coding equipment according to claim 2 as soon as it is accumulated with the are recording means which only a predetermined field carries out reading appearance of the image to memory, and the above-mentioned filtering means accumulates.
[Claim 20] the image coding equipment characterized by level and realizing with a filtering means to hang a vertical filter to these images field in image coding equipment according to claim 3 as soon as it is accumulated with the are recording means which only a predetermined field carries out reading appearance of the image to memory,

and the above-mentioned filtering means accumulates.

[Claim 21] Image coding equipment characterized by having an end-of-measurement means to complete statistic measurement of the above-mentioned algebraic-sign-ized means for every coding pass, and the layer structuring means which carries out layer structuring of the bit plane in image coding equipment according to claim 1 in a coding pass generation means to generate coding pass for every above-mentioned bit plane.

[Claim 22] Image coding equipment characterized by having an end-of-measurement means to complete statistic measurement of the above-mentioned algebraic-sign-ized means for every coding pass, and the layer structuring means which carries out layer structuring of the bit plane in image coding equipment according to claim 2 in a coding pass generation means to generate coding pass for every above-mentioned bit plane.

[Claim 23] Image coding equipment characterized by having an end-of-measurement means to complete statistic measurement of the above-mentioned algebraic-sign-ized means for every coding pass, and the layer structuring means which carries out layer structuring of the bit plane in image coding equipment according to claim 3 in a coding pass generation means to generate coding pass for every above-mentioned bit plane.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the image coding equipment and the image coding approach of performing coding by the format based on JPEG(Joint Photographic Experts Group)-2000 specification. As an applicable field, the compressor of the texture used by the digital camera of a still picture and a dynamic image, a camcorder, the codec for a monitor, the codec of the visual equipment for broadcast, the codec of a non-linear-editing machine, the codec of PDA (Personal Digital Assistance) or cellular-phone internal organs, the authoring tool on PC (Personal Computer), image edit software, the game, and three-dimension CG (Computer Graphic) or its software module is the main fields of the invention.

[0002]

[Description of the Prior Art] There is a JPEG method standardized by ISO (InternationalOrganization for Standarization) as a conventional typical picture compression method. It is known that this will offer good coding / decryption image when a comparatively high bit is assigned using DCT (Discrete Cosine Transform).

However, when the coding number of bits is lessened to some extent, a block distortion peculiar to DCT becomes remarkable, and degradation comes to be subjectively conspicuous. Apart from this, with the filter which combined the high-pass filter called a filter bank in an image, and the low pass filter, it divides into two or more bands, and research of the method which encodes for every bands of those prospers recently. Also in it, since there is no fault that block distortion becomes remarkable by the high compression which becomes a problem by DCT, wavelet transform coding is seen as a hopeful as a new technique replaced with DCT.
[0003] JPEG-2000 specification international-standards-ization is due to complete in December, 2000 -- this wavelet transform -- high -- the means which combined efficiency entropy code modulation and algebraic-sign-ization is adopted, and the big improvement of coding effectiveness is realized compared with JPEG. However, these international standards have defined only the specification by the side of a decoder, and an encoder side can be designed freely. Since specification generally exists on the other hand neither about the relief means of processing of an encoder with a heavy load, nor the effective means of the rate control stated by this invention, establishment of know how becomes more important than anything. Moreover, in JPEG, there is also the need of encoding multiple times, plentifully until the rate control for realizing target compressibility is difficult and acquires desired value. Since this leads to buildup of the processing time, coding is wanted to obtain the target amount of signs at once.
[0004]
[Problem(s) to be Solved by the Invention] From the above background, it aims at realizing the following technical problems by this invention in the image coding equipment and the image coding approach of performing coding by the format based on JPEG-2000 specification. Realize the amount of target signs by one coding processing to the 1st. Realize the amount control of signs of the coding effectiveness in which there are few the count loads and storage loads of rate control, and they are expensive, to the 2nd. The amount control of signs stabilized [3rd] not only in a still picture but in the dynamic image is realizable. The amount control of signs stabilized also to the dynamic image various type in the 4th is realizable.
[0005]
[Means for Solving the Problem] The image coding equipment and the image coding approach of performing coding by the format based on JPEG-2000 specification of this invention A filtering means to give wavelet transform to an input image, A bit plane generation means to develop a wavelet transform multiplier to the bit plane from the most significant bit (MSB) to the least significant bit (LSB), A coding pass generation means to generate coding pass for every bit plane, and an algebraic-sign-ized means to perform algebraic-sign-ization within coding pass, The amount control means of signs which controls the amount of signs to become the

target amount of signs from the generated algebraic sign, In the image coding equipment which performs coding by the format based on JPEG-2000 specification which consists of packet generation means to add a header to the algebraic sign after the amount control of signs, and to generate a packet, it has any one of three kinds of the following means.

[0006] After processing all **** coding pass and generating a coding code stream as the 1st means, it has a coding code stream cut-off means to omit the back of a coding code stream so that it may become the target amount of signs.

[0007] As the 2nd means, with a **** coding pass generation means, when the amount of signs of the target set up beforehand is reached, it has a coding termination means to stop coding.

[0008] With a storage means to memorize beforehand the coding number of passes for every subband generated by **** filtering as the 3rd means, and a **** coding pass generation means, it has a coding pass termination means to end **** coding pass within this coding number of passes.

[0009] According to this invention, the following operations are carried out. In the image coding equipment and the image coding approach of performing coding by the format based on JPEG-2000 specification of this invention, a filtering means to perform wavelet transform filters by the filter bank which consists of a low-pass filter and a high pass filter in an input image, and computes a transform coefficient. There is an operation which changes especially a low-pass subband recursively to two or more level. A quantization means has scalar quantity child-ization usually used well, i.e., the operation which does the division of the transform coefficient value with a predetermined step size. A coding pass generation means to generate coding pass for every bit plane constitutes the bit plane from the most significant bit (MSB) to the least significant bit (LSB) from a transform coefficient within a predetermined coding block unit, and has the operation which processes **** coding pass. An algebraic-sign-ized means is called out of coding pass, and it has the operation which performs predetermined algebraic-sign-ization, learning by measuring a statistic. In the amount control means of signs which carries out rate control of the amount of signs so that it may become the target amount of signs from the generated algebraic sign, a coding code stream cut-off means has the operation which omits some above-mentioned coding pass so that it may bring close to the target amount of signs.

[0010]

[Embodiment of the Invention] Hereafter, the gestalt of operation of the image coding equipment and the image coding approach of performing coding by the format based on JPEG-2000 specification by this invention is explained.

[0011] The gestalt of [gestalt of the 1st operation] book operation is 1 operation gestalt of this invention indicated in the 1st term of a claim. The wavelet transform section 1 which drawing 1 is the block diagram showing the configuration of the image

coding equipment of this operation gestalt, and gives wavelet transform to an input image, The bit plane coding pass generation section 2 which develops a wavelet transform multiplier to the bit plane from the most significant bit (MSB) to the least significant bit (LSB), The algebraic-sign-ized section 3 which performs algebraic-sign-ization within coding pass, and the rate control section 4 which controls the amount of signs to become the target amount of signs from the generated algebraic sign, It has the header generation section 5 which generates a header, and the packet generation section 6 which adds a header to the algebraic sign after the amount control of signs, and generates a packet, and is constituted. Here, the EBCOT (Embedded Coding with Optimized Truncation) coding section 10 consists of the bit plane coding pass generation section 2 and the algebraic-sign-ized section 3.

[0012] Next, actuation of the image coding equipment of this operation gestalt is explained. Wavelet transform in the wavelet transform section 1 is realized by the filter bank which usually consists of a low-pass filter and a high pass filter. Therefore, since the digital filter usually has the impulse response (filter coefficient) of two or more tap length, it is necessary to buffer beforehand the input image which can filter. However, with the gestalt of this operation, it has removed from the component of drawing 1 .

[0013] In the wavelet transform section 1 which inputted the minimum image S100 required for a FIRITA ring, filtering which performs wavelet transform is performed and the wavelet transform multiplier S101 is generated by the above here. The subband when carrying out wavelet division to the 2nd stage is shown in drawing 4 . In addition, although wavelet transform usually takes means to repeat and change a low-pass component like the minimum region subband LL 2 to the 2nd level, the low **** subband LH 2 and the height region subband HL2, and the highest region subband HH2, like drawing 4 , this is because many of energy of an image is concentrating on the low-pass component.

[0014] In addition, in the case of drawing 4 , the number of level of wavelet transform is 2, consequently the minimum region subband LL 2 to the 2nd level, the low **** subband LH 2 and the height region subband HL2, the highest region subband HH2, the low **** subband LH 1 of the 1st level and the height region subband HL1, and a total of seven subbands of the highest region subband HH1 are generated. In addition, although only a low-pass component is usually recursively filtered with a wavelet transform means, it cannot be overemphasized that means other than this also exist.

[0015] Next, the wavelet transform multiplier S101 is inputted and entropy code modulation is performed in the bit plane coding pass generation section 2. It explains especially with the gestalt of this operation, taking the entropy code modulation called EBCOT (Embedded Coding with Optimized Truncation) defined by JPEG-2000 specification for an example (reference: ISI/IEC FDIS 15444-1, JPEG-2000Part-1

FDIS, and 18 August 2000).

[0016] Before explanation of EBCOT, drawing 5 is used and explained about the concept of a bit plane. Drawing 5 A assumes the quantization multiplier which consists of four length and the multiplier of a total of 16 pieces of four width. It will be set to 1101, if the thing of max [absolute value] is 13 and is made into a binary representation among this multiplier of 16 pieces. Thus, it has the multiplier value by the wavelet transform multiplier S101, respectively.

[0017] When performing EBCOT coding, as shown in drawing 5 B It is made to carry out the sequential slice of the absolute value of the multiplier value by the wavelet transform multiplier S101 in each bit from the least significant bit (LSB:Least Significant Bit) to the most significant bit (MSB:Most Significant Bit). The bit plane of the absolute value which has the multiplier value of "1" or "0" corresponding to each sample (this is hereafter called absolute value bit plane.) While generating four kinds of absolute value bit planes in this case, as shown in drawing 5 C, the bit plane (this is hereafter called sign bit plane.) of the sign of "+" of each multiplier value and "-" is generated.

[0018] Therefore, the bit plane of the absolute value of this drawing 5 B consists of four planes. All the elements of each bit plane of taking the number of 0 or 1 are obvious. On the other hand, as for a sign, only -6 is 0 or a positive number in a negative number except it. Therefore, the plane of a sign becomes like this drawing 5 C.

[0019] EBCOT is a means which encodes while measuring the statistic of the multiplier within the block for every block of predetermined magnitude. Per block of the predetermined size called a code block (code-block), entropy code modulation of the quantization multiplier is carried out. A code block is independently encoded for every bit plane in the direction of LSB from MSB. The sizes of a code block in every direction are the exponentiations of 2 from 4 to 256, and the magnitude usually used has 32x32 and 64x64,128x32 grade. Suppose that the multiplier value of a wavelet field is expressed with the binary number with a sign which is n bits, and a bit n-2 expresses each bit from LSB to MSB from a bit 0. The remaining 1 bits are a sign. Coding of a code block is performed by three kinds of coding pass (pass) as follows in an order from the bit plane (bit-plane) by the side of MSB.

[0020] as a coding method [as opposed to the multiplier value in an absolute value bit plane by EBCOT coding] -- SIG -- three kinds of coding pass called NIFIKANSU propagation pass (SignificancePropagation Pass), magnitude RIFAIMENTOPASU (Magnitude Refinement Pass), and cleanup pass (Cleanup Pass) is specified.

[0021] The sequence that three coding pass is used is shown by drawing 6 . In drawing 6 , the bit plane (bit-plane) by the side of MSB (n-2) is first encoded with cleanup pass (Cleanup Pass). It goes to the LSB side one by one. Then, a bit plane (bit-plane) (n-3), Bit plane (bit-plane) (n-4) ... coding of each bit plane of a bit plane (bit-plane) (0)

NIFIKANSU propagation pass (Significance Propagation Pass) three coding pass (pass) -- SIG -- It is carried out by using in order of magnitude RIFAIMENTOPASU (Magnitude Refinement Pass) and cleanup pass (Cleanu p Pass).

[0022] However, it writes to a header with the bit plane of what position 1 comes out for the first time from the MSB side actually, and the bit plane of the first oar 0 is not encoded.

[0023] Rate control is performed by taking a trade-off of the amount of signs, and image quality by repeating and using three kinds of coding pass (pass), encoding, going by this sequence, and closing coding even with the coding pass (pass) of the arbitration of the bit plane of arbitration.

[0024] Next, the scan (scanning) of a multiplier is explained using drawing 7 . In drawing 7 , a code block (code-block) is divided into Stripe ST for every multiplier of four pieces which are height of 4 pixels. The width of face of Stripe ST is equal to the width of face of a code block (code-block). the inside of the sequence of the order of a scan being the sequence of following all the multipliers within one code block (code-block), and tending toward the train of a left train to the right in the sequence to the lower stripe ST, and Stripe ST from the upper stripe ST in a code block (code-block), and a train -- the bottom from a top -- ** -- it is the sequence to say. In each coding pass (pass), all the multipliers of a code block (code-block) are processed in order of this scan.

[0025] Hereafter, three coding pass (pass) is described. first, the 1st SIG -- NIFIKANSU propagation pass (Significance Propagation Pass) is explained. SIG which encodes a certain bit plane -- NIFIKANSU propagation pass (Significance Propagation Pass) -- about eight multiplier [at least one] -- SIG -- as [be / it / NIFI cant (Significant)] -- non -- SIG -- the value of the bit plane (bit-plane) of a NIFI cant (non-Sign ificant) multiplier -- algebraic sign It changes. The value of the encoded bit plane (bit-plane) is 1. A case continues and algebraic-sign-izes whether a sign is + or it is -.

[0026] here -- SIG -- the language "NIFIKANSU (Significance)" is explained. SIG -- the condition that an encoder has NIFIKANSU (Significance) to each multiplier -- it is -- SIG -- the initial value of NIFIKANSU (Significance) -- non -- SIG -- the time of 1 being encoded by 0 showing NIFI cant (non-Significant), and its multiplier -- SIG -- it changes to 1 showing NIFI cant (Significant), and henceforth, it is always 1 and continues. therefore, SIG -- NIFIKANSU (Significance) can also be said to be the flag which shows whether the information on a significant digit was already encoded.

[0027] Next, magnitude RIFAIMENTOPASU (Magnitude Refinement Pass) is explained to the 2nd. SIG which encodes a bit plane (bit-plane) in RIFAIMENTOPASU (Refinement Pass) which encodes a bit plane (bit-plane) -- SIG which has not encoded with NIFIKANSU propagation pass (Significance Propagation Pass) -- NIFI -- cant (Significant) -- BITTOPU of a multiplier The value of a lane (bit-plane) is

algebraic-sign-ized.

[0028] And cleanup pass (Cleanup Pass) is explained to the 3rd. SIG which encodes a bit plane (bit-plane) with the cleanup pass (Cleanup Pass) which encodes a bit plane (bit-plane) -- it has not encoded with NIFIKANSU propagation pass (Significance Propagation Pass) -- non -- SIG -- NIFI -- cant (non-Significant) -- the value of the bit plane (bit-plane) of a multiplier is algebraic-sign-ized. When the value of the encoded bit plane (bit-plane) is 1, it continues and algebraic-sign-izes whether a sign is + or it is -.

[0029] In addition, in algebraic-sign-ization with the above three coding pass (pass), ZC (ZeroCoding), RLC (Run-Length Coding), SC (Sign Coding), and MR (Magnitude Refinement) are properly used according to a case, measuring the statistic of algebraic-sign-izing for every code block unit. The algebraic sign called MQ coding here is used. MQ coding is the binary algebraic sign of the study mold specified by JBIG2 (reference: ISO/IEC FDIS 14492, "Lossy/Lossless Codingof Bi-level Images", March 2000). By JPEG-2000 specification, there are a total of 19 kinds of contexts with all coding pass (pass).

[0030] The above is the explanation which took the means of JPEG-2000 specification of the coding pass generation section 2 which generates coding pass for every bit plane, and the algebraic-sign-ized section 3 against the example. In addition, the claim of the content which encodes independently for every block, and closes and processes statistic measurement of algebraic-sign-izing like the gestalt of said operation in the coding pass generation section 2 which generates coding pass for every bit plane in a **** coding block (the above-mentioned example code block (code-block)) is carried out by claim 9.

[0031] Then, latter processing is explained using drawing 1 . In the rate control section 4, after processing all bit plane coding pass, when the amount of signs of the algebraic sign S103 which is the output of the algebraic-sign-ized section 3 is counted and the target amount of signs is reached, the algebraic sign after it is omitted. Therefore, since the coding pass of all bit planes is processed, a load is large, but since the coding code stream cut-off means omitted just before exceeding the amount of signs are taken, it can hold down to the target amount of signs certainly.

[0032] In the header generation section 5 which inputted the algebraic sign S104 after the completion of the amount control of signs, it carries out, for example based on the **** algebraic sign S104, and the additional information (for example, the number of the coding pass (pass) within a code block (code-block), the data length of a compressed code stream, etc.) within a code block (code-block) is outputted as a header S105. Furthermore, in the packet generation section 6, the above-mentioned algebraic sign S104 and a header S105 are doubled, and a packet S106 is generated and outputted.

[0033] The gestalt of [gestalt of the 2nd operation] book operation is 1 operation

gestalt indicated in the 2nd term of a claim. Always counting the amount of signs sent out from an algebraic sign S103 by the coding termination means, in order to mitigate the load of coding more, although the coding code stream (algebraic sign) was omitted with the coding code stream cut-off means, after processing all bit plane coding pass, when the target amount of signs is reached, **** coding processing is stopped by the rate control section 4 of the 1st operation gestalt. In this case, it is necessary to always count the accumulated of the amount of signs and the amount of target signs which are sent out from an algebraic sign S103, and to measure them, and actuation by the rate control section 4 becomes complicated rather than the 1st operation gestalt in the rate control section 4. However, as mentioned above, since it is not necessary to encode the coding pass of all bit planes, the load of coding has the advantage mitigated.

[0034] The gestalt of [gestalt of the 3rd operation] book operation is 1 operation gestalt indicated in the 3rd term of a claim. Drawing 2 is the block diagram showing the configuration of other image coding equipment of this operation gestalt, and, in addition to the configuration of drawing 1 , is equipped with the coding pass table 7 which memorizes beforehand the coding number of passes for every subband generated by filtering.

[0035] Next, actuation is explained. The wavelet transform multiplier S101 is developed by the appearance stated with the gestalt of the 1st operation in a bit plane, and coding pass is generated for every bit plane. Here, although it is the point of rate control which coding pass is omitted by choosing which coding pass in order to obtain the target amount of signs, but it changes [in which subband the effect which it has on image quality changes also with coding pass, and the coding pass has it, and].

[0036] Therefore, the amount of signs of the coding pass within a code block (code-block) and the amount of distortion (it is related to degradation of image quality) produced by omitting it are calculated in information theory, and from a viewpoint of the rate distortion (Rate-Distortion) theory, an ideal determines whether to omit the coding pass or choose so that it may become the optimal. However, for this control implementation, it is not dramatically realistic from preparing the big memory for memorizing high count and the amount of distortion of a load.

[0037] Then, with this operation gestalt, when the upper limit of the coding number of passes within a code block (code-block) is set up and there is coding pass beyond it for every subband beforehand, coding pass termination means to omit coding pass compulsorily are taken. In this case, it is necessary to grasp the maximum of a coding number of passes on the bit plane which developed the wavelet transform multiplier. This is realized by referring to the coding pass table 7 which set up beforehand the coding number of passes for every subband.

[0038] Drawing 8 is the maximum of the coding pass with which it is assumed at the time of processing the coding pass of all bit planes, when encoding by loss loess (Loss

Less). In drawing 8 The coding number of passes of the minimum region subband LL 2 to the 2nd level 25, In the coding number of passes of 28 and the highest region subband HH2, 31 and the coding number of passes of the low **** subband LH 1 of the 1st level the coding number of passes of 28 and the height region subband HL1 28, [the coding number of passes of the low **** subband LH 2] [the coding number of passes of 28 and the height region subband HL2] The coding number of passes of the highest region subband HH1 is 31.

[0039] These numeric values assume the case where 5xreversible mold 3 filters (5 and 3 are the tap length of a filter) corresponding to loss loess (Loss Less) are used for G(guard bit for overflow prevention) = 2 bits of guard bits and wavelet transform which are defined by JPEG-2000 specification. In this case, it is known that the above coding pass shown by drawing 8 will not take place theoretically (described by the detailed above-mentioned JPEG-2000 FDIS specification document). Moreover, as for the gestalt of this operation, input image data assumes the case of 8 bits / component (bit/component).

[0040] Next, drawing 9 is the pattern of the coding pass of another type-A. In drawing 9 The coding number of passes of the minimum region subband LL 2 to the 2nd level 20, In the coding number of passes of 19 and the highest region subband HH2, 18 and the coding number of passes of the low **** subband LH 1 of the 1st level the coding number of passes of 12 and the height region subband HL1 12, [the coding number of passes of the low **** subband LH 2] [the coding number of passes of 19 and the height region subband HL2] The coding number of passes of the highest region subband HH1 is 7.

[0041] Rather than the thing corresponding to loss loess (Loss Less) of drawing 8 , the coding pass of type-A of drawing 9 is all subbands, and is understood that there are few coding numbers of passes. Generating of the amount of signs is suppressed by this few.

[0042] Then, drawing 10 is the pattern of the coding pass of other type-B. In drawing 10 The coding number of passes of the minimum region subband LL 2 to the 2nd level 23, In the coding number of passes of 21 and the highest region subband HH2, 20 and the coding number of passes of the low **** subband LH 1 of the 1st level the coding number of passes of 14 and the height region subband HL1 14, [the coding number of passes of the low **** subband LH 2] [the coding number of passes of 21 and the height region subband HL2] The coding number of passes of the highest region subband HH1 is 7.

[0043] drawing 10 -- drawing 9 -- overall -- a mackerel -- the coding number of passes in a band has increased. Since this is promoting generating of the amount of signs, in the case of drawing 10 , many amounts of signs occur rather than the case of drawing 9 . In addition, the claim of this is carried out by claim 8.

[0044] With the coding pass S102 for every bit plane chosen in the coding pass

generation section 2 which generates coding pass for every bit plane, the algebraic-sign-ized section 3 is called and an algebraic sign S103 is generated by the above-mentioned actuation. The actuation after it is the same as that of the 1st operation gestalt.

[0045] The gestalt of [gestalt of the 4th operation] book operation is 1 operation gestalt indicated in the 4th term of a claim. Although a coding pass termination means to control the amount of signs in the rate control section 4 with restrict beforehand the coding number of passes for every subband on the coding pass table 7 be take with the gestalt of said 3rd operation , since it be control of a coding pass unit to the last , in respect of the amount control of signs of high degree of accuracy , it be inadequate .

[0046] Therefore, further, as an additional means, when the amount of information of an algebraic sign S103 is supervised by the rate control section 4 and it is over the target amount of signs, actuation which omits said algebraic sign S103 is performed until it becomes the target amount of signs with a coding code stream cut-off means. The amount control of signs of high degree of accuracy is realized by this. In addition, the claim of this content is carried out by claim 4.

[0047] The gestalt of [gestalt of the 5th operation] book operation is 1 operation gestalt indicated in the 5th term of a claim. With the gestalt of said 4th operation, when the coding pass table 7 which determined beforehand the coding number of passes for every subband was prepared and the coding pass beyond it was generated, the amount control of signs was performed by omitting it with a coding code stream cut-off means. However, the input image is various, two or more coding pass tables which registered the pattern of an inner coding number of passes the whole subband are prepared, and the change means which changes them with an image is effective. It can encode by this, always controlling the amount of signs. In addition, the claim of this content is carried out by claim 5.

[0048] The gestalt of [gestalt of the 6th operation] book operation is 1 operation gestalt indicated in the 6th term of a claim. This operation gestalt is the application of said 5th operation gestalt. When an input image is a dynamic image (treating as a continuous still picture is possible), as mentioned above, coding is difficult, there are some which many amounts of signs generate depending on an image, and coding is easy and what has few generating of the amount of signs has it. Therefore, it is not a best policy to determine a coding number of passes with reference to said coding pass table of one pattern to these various images.

[0049] The effective amount control of signs can be performed by using the description of the amount of generating signs of the image encoded like before which followed and showed the coding number of passes to drawing 10 from drawing 8 , or the present image. This operation gestalt uses the amount of generating signs of the image in front of one. Storage maintenance of the amount of generating signs of the

image in front of one is carried out, and when this amount of signs has exceeded the amount of signs assigned to the amount of signs of the image per [which was decided beforehand] frame, or its frame, specifically, the present image for coding should be controlled in the direction which controls the amount of generating signs.

[0050] Therefore, the table whose amount of generating signs decreases is chosen from the reference tables of the coding pass prepared by the selection means, and this is referred to. [two or more] In addition, since it is related to said coding number of passes, as many tables into which this coding number of passes was changed delicately are prepared, it cannot be overemphasized that fine control is attained. However, since the memory capacity of the part many is needed, the number of tables will be determined in consideration of a actual trade-off.

[0051] On the contrary, when the amount of signs is less than the amount of signs assigned to the amount of signs of the image per [which was decided beforehand] frame, or its frame, the present image for coding should be controlled in the direction which increases the amount of generating signs, and should just choose the table which is equivalent to it with a selection means.

[0052] The gestalt of [gestalt of the 7th operation] book operation is 1 operation gestalt indicated in the 7th term of a claim. This operation gestalt is the application of said 5th operation gestalt. With this operation gestalt, when an input image is a dynamic image, said table is chosen using the characteristic quantity of the current image for coding. The absolute value sum of a wavelet transform multiplier is taken, when larger than the threshold which has this value with a threshold judging means, it specifically judges that there is much generating amount of information, and the coding pass table which controls the amount generating of signs is chosen. Moreover, an image may be divided into some subregions, the variance sum of the pixel in these fields may be taken, and the threshold judging of this may be carried out. When this variance is larger than a criterion, since it can judge that fine texture exists, it considers that the amount of signs increases, and the coding pass table which controls the amount generating of signs is chosen.

[0053] On the contrary, when a **** variance is small, the table which increases the amount generating of signs is chosen. In addition, usually each of these processings will perform threshold processing, some thresholds of a variance will be decided beforehand, and a coding pass table will be chosen by the size judging with the threshold by the threshold judging means.

[0054] The gestalt of [gestalt of the 8th operation] book operation is 1 operation gestalt indicated in claim the 12th, 13, and 14 term. With the operation gestalt described until now, although the transform coefficient after wavelet transform was developed to the bit plane, the quantization section 8 is formed like drawing 3 between the wavelet transform section 1 and the bit plane coding pass generation section 2. Therefore, the wavelet transform multiplier S101 is quantized in the quantization

section 8, and the quantization multiplier S108 is outputted.

[0055] As a quantization means, the formation of a scalar quantity child which usually does the division of the wavelet transform multiplier S101 with a quantization step size is common, and this technique is included also in the specification of JPEG-2000. Moreover, about the scalar quantity child-ized means of the wavelet transform multiplier S101, the claim is carried out by claim 11.

[0056] Coding pass is generated by the appearance which the quantization multiplier S108 was developed by the bit plane in the bit plane coding pass generation section 2, and was stated with said 1st operation gestalt at every code block (code-block). Since the absolute value of the quantization multiplier S108 usually becomes smaller than the absolute value of said wavelet transform multiplier S101 with a quantization means, there is the description which decreases so much.

[0057] From the coding pass S109 of every [which was developed by the bit plane] code block (code-block), the algebraic-sign-ized section 3 is called if needed, respectively, and an algebraic sign S110 is outputted. Subsequent actuation is the same as that of what was already described, and is good.

[0058] In addition, if it quantizes so that it may become a coding number of passes for every subband as shown by drawing 9 and drawing 10 as a result using this quantization means, it cannot be overemphasized that the same object as said operation gestalt is realizable. Under the present circumstances, the means of coding pass generation in said bit plane coding pass generation section 2 is omissible.

[0059] The gestalt of [gestalt of the 9th operation] book operation is 1 operation gestalt indicated in claim the 18th, 19, and 20 term. It was said that the wavelet transform means stated with said 1st operation gestalt is realized by covering a low-pass filter and a high pass filter over level and a perpendicular direction, and performing it repeatedly until two or more subbands are obtained. However, if a means to perform wavelet transform of a full screen needs to memorize and hold the transform coefficient of only the pixel measurement size of a full screen, and it is realistic when the size of an input image is large, there is. [no] Therefore, what is necessary is just to take a filtering means to input a pixel sample required for filtering at any time, memorizing and holding the necessary minimum input image or multiplier, and carrying out to a line buffer by repeating wavelet transform.

[0060] Usually, the filter used for filtering wavelet transform is a filter of two or more taps, and if the number of lines is accumulated as required for this filtering, it can perform wavelet transform filtering promptly.

[0061] Drawing 11 to drawing 14 is drawing showing the processing of line base wavelet transform which shows the concrete actuation about the above-mentioned wavelet transform and wavelet division processing. In drawing 11 , it accumulates in the line buffer 112 which is a data read-out memory means for every line of the data line 111 of the input image 110 at step S1 first, and data are stored for every line until

a vertical filter becomes possible to the data in a line buffer 112 at step S2.
[0062] In drawing 12 , if the number only of lines which is required for vertical filtering of wavelet transform is stored in a line buffer 112, at step S3, vertical filtering is performed, and level filtering will be performed continuously. At this event, the wavelet transform multiplier value of four subbands by the side of low-pass (LL2, LH2, HL2, HH2) is determined, and quantization is performed by step S4 to three subbands by the side of the high region shown by the subband multiplier 120 for quantization (LH1, HL1, HH1). The subband multiplier line [finishing / quantization / by this] 121 is generated.
[0063] On the other hand, at step 5, the wavelet transform multiplier of a minimum region subband (LL2) is again accumulated in the line buffer 112, and this continues it until the number only of lines which is required for vertical filtering is stored. Therefore, this wavelet transform multiplier is accumulated in the line buffer 112 which is a buffer means. Moreover, at step S6, if the number only of lines which is required for vertical filtering is stored in the buffer of said minimum region subband, level filtering will be performed following vertical filtering for the next wavelet division stage generation.
[0064] Consequently, at step S7, as shown in the left figure of drawing 13 , since the wavelet transform multiplier value 130 of four subbands of the 2nd stage of a minimum region subband is decided here, the latter part is quantized promptly and a quantization multiplier is outputted.
[0065] In addition, when storing the number only of lines which is required for vertical filtering of the wavelet transform of actuation of said step S2 (considerable when the number of division stages is 1), or to store the number only of lines which is required for vertical filtering of actuation of step S5 (considerable when the number of division stages is 2), it is necessary to memorize and hold a wavelet transform multiplier at a buffer. At this time, the wavelet transform multiplier in every line in each division stage is sent to a buffer in order, and is memorized here.
[0066] On the other hand in the case of vertical filtering by actuation of step S3, or actuation of step S6, the required wavelet transform multiplier for several line minutes accumulated in the buffer section is read from a buffer, and vertical filtering is hung on these. It continues until all division stages end the above actuation.
[0067] When the height (H) of a block of the batch of EBCOT defined by JPEG-2000 specification is reached by step S8 with the entropy code modulation of a code block (code-block) of 131 lines of the quantization multiplier of the subband (LH1, HL1, HH1) of the 1st division stage by the side of a high region with the already expressed means, and especially the gestalt of this operation, EBCOT is performed as entropy code modulation.
[0068] In drawing 14 , still more nearly similarly, when 140 lines of the quantization multiplier of the subband (LL) of the 2nd division stage by the side of low-pass reach

the height (H) of a block of the batch of EBCOT as entropy code modulation of the block base by step S9, EBCOT is performed as this entropy code modulation. In addition, the subband (LH1, HL1, HH1) of the 1st division stage by the side of a high region serves as the EBCOT executed quantization multiplier field 141. By repeating and performing the above actuation to required wavelet division level, the wavelet transform + quantization + entropy code modulation of all screens is completed.

[0069] The gestalt of [gestalt of the 10th operation] book operation is 1 operation gestalt indicated in claim the 21st, 22, and 23 term. The algebraic-sign-ized section 3 was called from the coding pass in the bit plane generated in the bit plane coding pass generation section 2 with the operation gestalt about claim 1, claim 2, and claim 3 publication, and the actuation which outputs an algebraic sign was already described. In this case, statistic measurement of an algebraic sign is continuously performed with adjoining coding pass. Although coding effectiveness can be raised by this, in consideration of the independence of coding pass, statistic measurement of an algebraic sign can also be completed for every coding pass with an end-of-measurement means to complete statistic measurement.

[0070] In this case, since the amount of generating signs for every coding pass can be written in a packet header, there is an advantage that procedure becomes easy, rather than the case where the amount of generating signs for two or more coding pass of every is calculated and written in. Moreover, since only the number of coding pass is made by the packet by this in one bit plane, by carrying out layer structuring of this multi-packet with a layer structuring means, it can use for the cure against an error and the progressive function of JPEG-2000 specification which can be used for wireless transmission can be realized.

[0071] When realizing the coding equipment and the means of generating the coding code stream based on JPEG-2000 according to the gestalt of operation mentioned above, it is effective in realizing efficiently the amount control means of signs to which examination is not fully carried out for the conventional substandard. Moreover, since there is effectiveness which mitigates the count load in the case of the amount control of signs compared with the means in consideration of a rate distortion property, it is effective in the ability to perform high-speed coding. Therefore, there is effectiveness which encodes many frame numbers per unit time amount to a dynamic image.

[0072]

[Effect of the Invention] As mentioned above, when realizing the image coding equipment and the means of generating the coding code stream based on JPEG-2000 specification according to this invention, it is effective in realizing efficiently the amount control means of signs to which examination is not fully carried out for the conventional substandard.

[0073] Moreover, since there is effectiveness which mitigates the count load in the

case of the amount control of signs compared with the means in consideration of a rate distortion property, it is effective in the ability to perform high-speed coding. Therefore, there is effectiveness which encodes many frame numbers per unit time amount to a dynamic image.

[0074] Furthermore, since it has a means to refer to the table which determined the coding number of passes for every subband, it is effective in performing always exact control by choosing a table also with the optimal amount control of signs of a dynamic image with sharp fluctuation. Moreover, even if compared with the means in consideration of a rate distortion property, it is effective in offering equal high definition.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the block diagram showing the configuration of the image coding equipment of this operation gestalt.

[Drawing 2] It is the block diagram showing the configuration of other image coding equipment.

[Drawing 3] It is the block diagram showing the configuration of other image coding equipment.

[Drawing 4] It is drawing showing the subband when carrying out wavelet division to the 2nd stage.

[Drawing 5] It is the explanatory view of a bit plane and drawing 5 A is [the bit plane of the absolute value of a multiplier and drawing 5 C of wavelet transform multiplier and drawing 5 B] the bit planes of the sign of a multiplier.

[Drawing 6] It is drawing showing the procedure of the coding pass of JPEG-2000 specification.

[Drawing 7] It is drawing showing the scanning path within a code block.

[Drawing 8] It is drawing (wavelet number of partitions = 2) having shown the coding number of passes for loss loess.

[Drawing 9] It is drawing (wavelet number of partitions = 2) having shown a certain coding number of passes.

[Drawing 10] It is drawing (wavelet number of partitions = 2) having shown other coding numbers of passes.

[Drawing 11] It is drawing (the 1) showing processing of line base wavelet transform.

[Drawing 12] It is drawing (the 2) showing processing of line base wavelet transform.

[Drawing 13] It is drawing (the 3) showing processing of line base wavelet transform.

[Drawing 14] It is drawing (the 4) showing processing of line base wavelet transform.

[Description of Notations]

1 .... The wavelet transform section, 2 .. Bit plane coding pass generation section, 3 [.. Packet generation section,] .... The algebraic-sign-ized section, 4 .. A rate control section, 5 .. The header generation section, 6 7 .... A coding pass table, 8 .. The quantization section, S100 .. Input image, S101 .... A wavelet transform multiplier, S102 .. The wavelet transform multiplier developed by the bit plane, S103 .... An algebraic sign, S104 .. The algebraic sign after rate control, S105 .. Header, S106 .... The coding code stream, S107 which were packet-ized .. The coding number of passes by which reading appearance was carried out from the coding pass table, S108 [.. The algebraic sign after rate control, S112 / .. A header, S113 / .. Packet-ized coding code stream] .... A quantization multiplier, S109 .. The quantization multiplier, S110 which were developed by the bit plane .. An algebraic sign, S111